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Pubovaginal Sling

Jerry G. Blaivas

The use of a pubovaginal sling for the treatment of sphincteric incontinence has a long and variegated history. Von Giordano is credited with first describing a sling technique in 1907.¹ He fashioned a pedicle graft of gracilis muscle that was passed around the urethra. In 1910, Goebell used a pedicle flap of pyramidalis muscle that was passed through the retropubic space on either side of the vesical neck and sutured in the midline beneath the urethra.² Although he reported a successful outcome in two children—one with spina bifida and one with epispadias—no meaningful data were presented. Moreover, because the muscle was left attached to its insertion on the pubis, there was no way to adjust the tension, particularly if the muscle was too short. To obviate this problem, Frangenheim modified the procedure by incorporating an adjacent portion of rectus fascia to the pyramidalis muscle.³ This technique provided sufficient length for the sling to pass around the urethra of a man who developed urinary incontinence after a perineal injury. In 1917, Stoeckel modified the procedure further. He plicated the vesical neck and raised bilateral rectangular flaps of rectus fascia and pyramidalis muscle. The flaps were passed through the retropubic space and around the plicated urethra and sutured in the midline.⁴ Further modifications of these techniques became known as the *Goebell-Stoeckel-Frangen-*

heim operation.^{5,6} These procedures were associated with a high complication rate, particularly urinary infection, hemorrhage, and obstruction, and were performed only infrequently for the better part of 30 years.

In 1931, Miller described a technique of passing a pedicle graft of pyramidalis or rectus muscle superficial to the pubis and around the urethra.⁵ He believed that this obviated the need for an extensive dissection of the vesical neck from above and thereby lessened the likelihood of bleeding or injury to the bladder or urethra. Aldridge presented a meticulously detailed description of his slightly modified surgical technique in a single case report in 1942.⁷ He raised bilateral rectus fascial strips that were detached laterally, passed through the rectus muscle, and sutured together in the midline beneath the urethra (Fig. 17-1). Further modifications were reported by a number of authors, but the procedure again fell into disfavor because of complications.⁸⁻¹⁶

The modern era of pubovaginal fascial sling surgery was introduced and popularized by the work of McGuire. In 1976, McGuire and colleagues introduced the concept of two generic types of sphincteric incontinence: urethral hypermobility and intrinsic sphincter deficiency.³⁶ They modified the Green classification by adding a new category, type III stress incontinence. Type

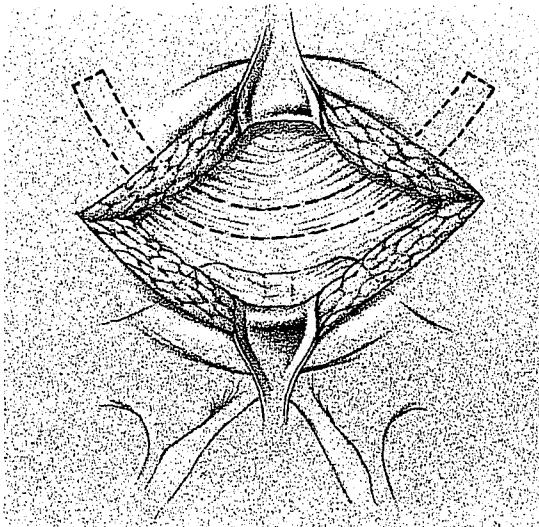


Figure 17-1. A 2 to 3 cm wide graft is outlined keeping the incision parallel to the direction of the fascial fibers. The incision is extended laterally to the point where the rectus fascia divides and passes to the internal and external oblique muscles. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93-101.)

III stress incontinence was defined by an absence of urethral hypermobility, a low (proximal) urethral pressure, and an open vesical neck at rest. As the concept of type III stress incontinence continued to evolve, it became known as intrinsic sphincter deficiency. In 1978, McGuire and Lytton reported an 80% success rate in patients with type III stress incontinence after construction of a pubovaginal sling.¹⁷ They stated that:

Most patients with stress incontinence can be treated successfully, either with anterior colporrhaphy or with an anterior urethropexy. These procedures have resulted in the correction of the hypermobility of the posterior urethra and maintenance of its correct anatomical location above the pelvic diaphragm, so that sudden changes in intra-abdominal pressure are transmitted equally to the bladder and proximal urethra. The choice

of procedure depends upon the degree of mobility of the posterior urethra and the resultant anatomic deformity. . . . However, there remains a small group of patients in whom stress incontinence persists despite adequate anatomical correction of the position of the urethra and hypermobility, and most of these patients have a low urethral closing pressure exerted over a short distance. Many have undergone a previous operation for stress incontinence so that mobilization, elevation and fixation of the urethra may be difficult because of scarring and rigidity of the periurethral tissues. Insertion of a pubovaginal sling in these cases has usually been successful.

In their technique, a combined abdominal and vaginal approach was used. A 1 × 12 cm strip of rectus fascia and external oblique was left attached about 2 cm from the midline. The vesical neck was exposed through the retropubic space. A midline anterior vaginal wall incision was made and a tunnel created on either side of the vesicourethral junction. The free end of the sling was passed through the rectus muscle, around the vesical neck, and back through the rectus muscle on the contralateral side. Tension in the sling was adjusted by measuring urethral pressure; the intention was to raise urethral pressure by about 10 cm H₂O. The bladder was opened to ensure that there was no injury, and the sling was secured to the rectus fascia. The bladder was drained by suprapubic cystotomy.

A subsequent series by McGuire and others documented a success rate of 82% in 80 women with type III stress incontinence.^{18,19} In this series, six women had concomitant urinary fistulas, and 28% had associated detrusor abnormalities. Most of the patients had failed previous attempts at surgical correction. Of the original 15 postoperative failures, 8 were due to detrusor instability or low compliance and 7 were due to persistent type III stress incontinence. Reoperation, including augmentation cystoplasty, repeat pubovaginal sling, and continent vesicostomy, resulted in an overall cure rate of 95%. Five patients (6%) had prolonged detrusor instability, and 18% required intermittent catheterization. Twelve of the patients on inter-

the degree of motor and the resultant never, there remains hom stress inconti- nence anatomical cor- urethra and hyper- patients have a low- tered over a short dis- a previous opera- o that mobilization, urethra may be diffi- rigidity of the peri- a pubovaginal sling been successful.

combined abdominal incision. A 1 × 12 cm strip of external oblique was taken in the midline. Through the retropubic vaginal wall incision made on either side of the free end of the rectus muscle, I back through the lateral side. Tension measuring urethral pressure raise urethral pressure. The bladder was intact, no injury, and the rectus fascia. The retropubic cystotomy. McGuire and others found 82% in 80 women success. In this series, incontinant urinary associated detrusor ab- patients had failed pre- correction. Of the 112 cases, 8 were due to noncompliance and 7 were type III stress inconti- nence. Using augmentation vaginal sling, and continence an overall cure rate of 90% had prolonged de- required intermittent catheterization in the patients on inter-

mittent catheterization had neurologic conditions (mostly myelodysplasia).

Types of Graft Used

Blaivas and others, using the surgical technique described subsequently, reported a 91% success rate of operation in 67 women with complicated type III stress incontinence who were followed for a mean of 3.5 years (range 1 to 9 years).²⁰⁻²² In their technique, a free graft of rectus fascia is passed around the vesical neck without any dissection through the retropubic space; the entire dissection is performed through a vaginal incision. The sling is sutured to the rectus fascia on either side with no tension at all. The operation was performed as a single procedure in 39 patients and was combined with an operation for pelvic floor prolapse in 10. In 18 women, it was combined with a urethral reconstruction procedure. Sixty-two patients (93%) had failed 1 to 19 previous operations for stress incontinence, with a median of 3 previous surgeries. Overall, 55 women (82%) were dry under all circumstances and did not have symptoms of detrusor instability. Six (9%) had mild episodes of urinary incontinence, which occurred less often than once per week, and six were failures. The main cause of failure was urge incontinence; only two patients had persistent stress incontinence. Forty-two patients (63%) were unable to void satisfactorily on discharge on the seventh postoperative day and were sent home with a suprapubic catheter. Another voiding trial was undertaken 4 weeks postoperatively, and 36 were able to void satisfactorily. The remaining six patients were treated with permanent intermittent self-catheterization. Four of these had neurogenic bladders preoperatively, and urinary retention was an expected outcome. In the remaining two patients, postoperative videourodynamics revealed urethral obstruction at the site of the sling.

In 1933, Price first reported the successful use of a free graft of fascia lata as a sling in a young girl with sphincteric incontinence owing

to sacral agenesis.⁶ Others have used this technique, and the results compare favorably with the series that use rectus fascia.^{1, 12, 23-25} Beck and colleagues reported a 92% success rate in 170 women, all of whom underwent the procedure after they had failed previous operations.²⁴ Only 3 of the 12 failures occurred because of recurrent stress incontinence; the remainder had persistent urge incontinence. For an excellent description of the surgical technique, the interested reader is referred to the work of Beck and Ridley^{1, 26} (Fig. 17-2).

In our experience, it has always been possible to obtain a satisfactory strip of rectus fascia for use as a sling, even in patients who have had more than a dozen retropubic operations. Nevertheless, some concern has been voiced about the advisability of using fascia for the sling, particularly in patients who have undergone multiple previous abdominal or retropubic operations. A number of surgeons have used synthetic material instead of fascia for construction of the

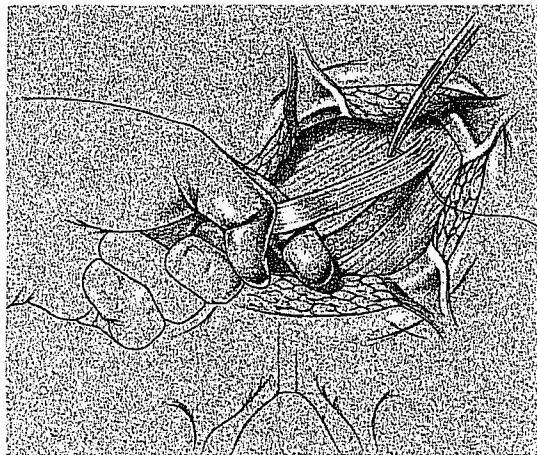


Figure 17-2. A no. 2-0 nonabsorbable running horizontal mattress suture is placed across the lateralmost portion of the graft, and the ends are left long. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93-101.)

sling. Ox fascia, dura, collagen, and Silastic have been tried with limited success.²⁷⁻²⁹ Synthetic polyester Dacron (Mersilene) has been used for almost four decades, but problems with erosion, infection, fistula, and sinus formation greatly limit its use.^{10, 11, 15, 16, 30-34} In 1962, Williams and TeLinde described their technique using synthetic Dacron.¹⁶ In this initial report, they cited an 83% cure rate in 12 patients. In one patient, the Dacron eroded into the urethra and was removed; a second patient developed a persistent sinus tract, but both of these patients were reportedly cured. Before this, these authors tried using a strip of nylon for the sling in two patients, both of whom ultimately developed abscess formation requiring complete removal. According to Ridley, the authors subsequently abandoned the use of synthetic material in favor of fascia lata because of the complication rate. Subsequently Moir reported an 83% "cure or substantial improvement" in 71 women with a Dacron sling.¹⁰

The most extensive experience with Dacron slings is that of Morgan and others.³²⁻³⁴ They reported an 81% to 90% success rate in a cumulative series of more than 300 women followed as long as 15 years. In one report, 283 women with recurrent stress incontinence and 9 with primary stress incontinence underwent a Marlex sling operation through a two-team retropubic and vaginal approach. The authors stressed two important aspects of surgical technique, which they believe is critical to their success: (1) the necessity of completely mobilizing the vesical neck and proximal urethra "from a bed of scar, followed by repositioning of the bladder neck in an intra-abdominal retropubic position," and (2) placing the sling around the vesical neck with no tension at all—they do not even sew the sling in place. With a minimum follow-up of 5 years (range, 5 to 12 years), the success rate was 81%.^{32, 33} A subsequent series of 82 patients had a 93% cure rate with a 1- to 4-year follow-up.³⁴ In 16 patients with a *sloughed urethra*, the sling was used in conjunction with construction of a vaginal flap neourethra. Ten of these procedures resulted in ero-

sion and stone formation. Only two of the slings eroded in the rest of the 274 patients. Two patients underwent urinary diversion because of *end-stage contracted bladder*, 12 patients had persistent bladder outlet obstruction, and 2 are on routine intermittent catheterization. Overall, 5% of their patients had persistent urinary frequency and urgency.

Morgan has replaced Marlex with Dexon mesh. Although the mesh is absorbable, a rapid ingrowth of scar occurs within days of implantation resulting in a strong fibrous sling. Initial results with this procedure are superior to those of the Marlex slings.*

Despite the long-term success rate cited, pubovaginal sling never achieved widespread popularity.^{8-12, 15-25, 26-30, 32-34, 35-38} This is primarily due to the perception that the procedure is technically more demanding than the standard urethropexy, and the complication rate, particularly in the hands of the inexperienced surgeon, is reportedly higher. The most common and troublesome complications are injury to the bladder or urethra, urinary retention, and detrusor instability. Urinary retention is largely preventable by insuring that the sling is passed beneath the vesical neck and sutured to the rectus fascia with no tension at all. In our experience, the major risk factor for developing post-operative detrusor instability is the presence of this symptom preoperatively. It may also be caused, however, if the sling is placed under too much tension, causing urethral obstruction. In our judgment, intraoperative injury to the bladder or urethra is no more likely during pubovaginal sling than any of the modified Peyrera operations. With either procedure, injury is entirely preventable by adhering to the surgical principles outlined by Aldridge in 1942.⁷

[I]t requires a painstaking technique which should not be undertaken by a surgeon who has not acquired a modern conception of the anatomic structures in the anterior vaginal wall about the urethra and bladder. Dissection in this

* Morgan JE. Personal communication, 1992.

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PUBOVAGINAL SLING

region is safe and nearly bloodless if carried out in the planes of cleavage described above. If these tissue planes are not followed, blood loss may be excessive and the bladder and urethra may be subjected to serious damage.

Despite these concerns, we believe that, for the experienced pelvic surgeon, pubovaginal sling offers the best chance for long-term cure of stress urinary incontinence, not only owing to complicated problems of intrinsic sphincter deficiency, but also owing to commonplace urethral hypermobility.

Indications

Historically the sling technique has been limited to patients who have failed previous surgery and those with intrinsic sphincter deficiency (type III stress incontinence). In a generic sense, intrinsic sphincter deficiency refers to malfunction of the intrinsic sphincteric properties of the vesical neck and proximal urethra. In the older literature, type III stress incontinence was recognized clinically by noting overt stress incontinence unaccompanied by appreciable descent of the vesical neck. With the advent of sophisticated multi-channel videourodynamics, intrinsic sphincter deficiency is diagnosed primarily by observing radiographic contrast material in the vesical neck and urethra in the absence of a detrusor contraction (an open vesical neck).^{20-22,36,37,39} Intrinsic sphincter deficiency is most commonly due to recurrent stress incontinence after failed previous surgery, but it is also seen in neurologic disorders affecting urethral sphincter function.^{20,21,36,37} In some instances, intrinsic sphincter deficiency and urethral hypermobility coexist. Current diagnostic methodology does not clearly distinguish the two entities. Studies by McGuire, however, suggest that measurement of the *leak point pressure* is an important variable that can distinguish the two.* A complete list of the causes of type III stress incontinence is as follows:

* McGuire EM. Personal communication, 1992.

Previous incontinence surgery
Myelodysplasia
Lumbosacral spinal cord injury
Anterior spinal artery syndrome
Radical hysterectomy
Abdominoperineal resection of the rectum

Operative Technique

The procedure is performed in the dorsal lithotomy position. A Foley catheter is inserted into the urethra and the balloon inflated with enough saline to facilitate palpation of the vesical neck. To minimize blood loss, the abdominal portion of the procedure is completed first. The fascial strip to be used for the sling is harvested and stored in sterile saline while the vaginal portion of the operation is completed.

A Pfannenstiel incision is made and carried down to the rectus fascia. The surface of the rectus fascia is dissected free of subcutaneous tissue, and a suitable site is selected for excision of the fascial strip. If the patient has had previous surgery, there may be considerable scarring. It is not necessary to find "scar-free" fascia. Even the most scarred tissue, not even recognizable as fascia, may be used. In more than 150 cases, we have always been able to find a suitable strip to harvest.

Two parallel horizontal incisions, 2 to 3 cm apart, are made near the midline in the rectus fascia. The incisions are extended superolaterally for the entire width of the wound, following the direction of the fascial fibers (see Fig. 17-1). If a longer strip is necessary, the incisions may be extended superiorly in a vertical direction at the lateralmost aspect of the wound. The undersurface of the fascia is freed from muscle and scar. Before excising the strip, each end of the fascia is secured with a long no. 2-0 nonabsorbable suture using a running horizontal mattress suture that is placed at right angles to the direction of the fascial fibers (Figs. 17-2 and 17-3). No attempt is made to enter the retropubic space. It is not necessary to mobilize or expose the bladder or vesical neck from above

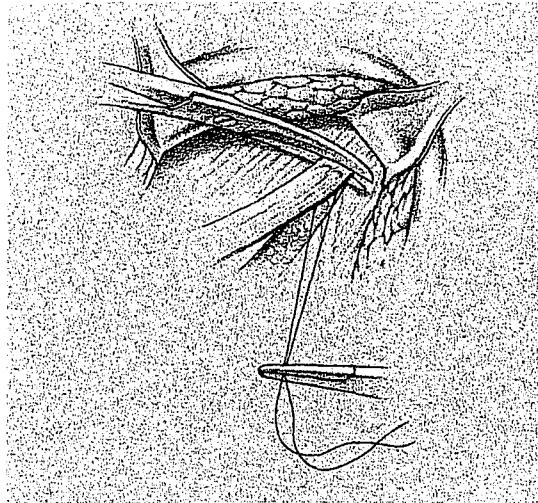


Figure 17-3. Each end of the fascial graft is transected approximately 1 cm lateral to the mattress suture. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93-101.)

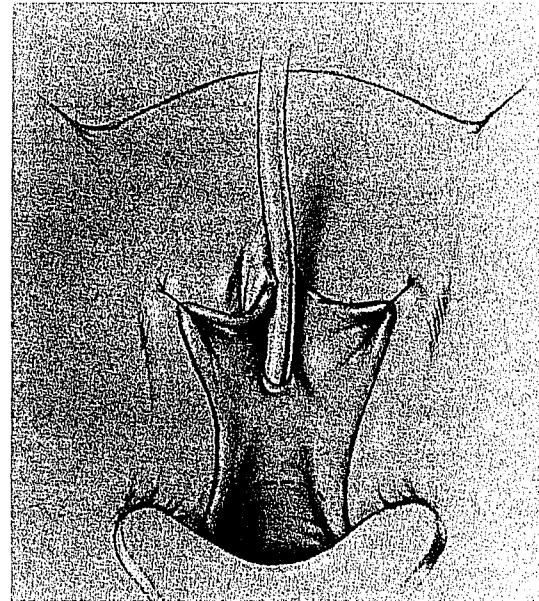


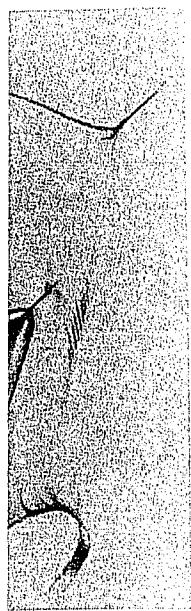
Figure 17-4. Vaginal incision. A slightly curved horizontal incision is made at the vesical neck. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93-101.)

because this is accomplished through the vaginal dissection. The fascial defect is closed and the wound is temporarily packed with saline-soaked sponges, as attention is turned to the vagina.

The vesical neck is identified by placing gentle traction on the Foley catheter and palpating the balloon. In most patients, the actual position of the vesical neck is about 2 cm proximal to the palpable distal edge of the balloon. A gently curved horizontal incision is made in the anterior vaginal wall with the apex of the curve over the vesical neck (Fig. 17-4). It is important that this incision be made in the proper plane—just beneath the vaginal epithelium and superficial to the endopelvic fascia. The proper plane is identified by noting the characteristic shiny white appearance of the undersurface of the anterior vaginal wall. Although the plane is usually described as being bloodless, this is not always the case, but it usually provides the least blood loss.

Even more importantly, this plane insures that the dissection will proceed lateral to the bladder and urethra. If the initial vaginal incision is even a few millimeters too deep, injury to these structures may occur.

A small posterior vaginal flap is made for a distance of about 2 cm, just wide enough to accept the sling but narrow enough to prevent the sling from moving after it is passed around the urethra. The lateral edges of the wound are grasped with Allis clamps and retracted laterally. The dissection continues just beneath the vaginal epithelium with a Metzenbaum scissors pointed in the direction of the patient's ipsilateral shoulder until the periosteum of the pubis or ischium is palpated with the tip of the scissors (Fig. 17-5). During this part of the dissection, it is important



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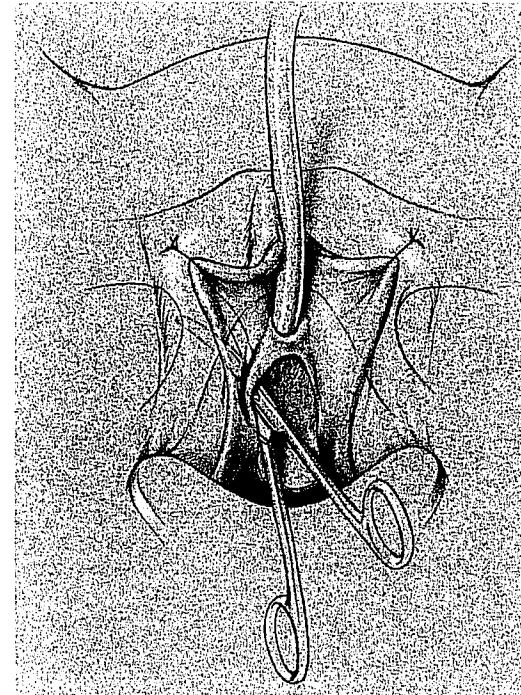


Figure 17-5. Dissection beneath the vaginal epithelium with a Metzenbaum scissors to create a tunnel for passage of the sling. The tips of the scissors are directed toward the patient's ipsilateral shoulder. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93–101.)

to stay as far lateral as possible. This is best accomplished by dissecting with the concavity of the scissors pointing laterally and by exerting constant lateral pressure with the tips of the scissors against the undersurface of the vaginal epithelium.

Once the periosteum is reached, the endopelvic fascia is perforated and the retropubic space entered. In most instances, this is easily accomplished with blunt dissection by the surgeon's index finger (Fig. 17-6). The tip of the finger, opposite the nail, palpates the periosteum. With the back edge of the fingertip, the bladder and urethra are mobilized medially as

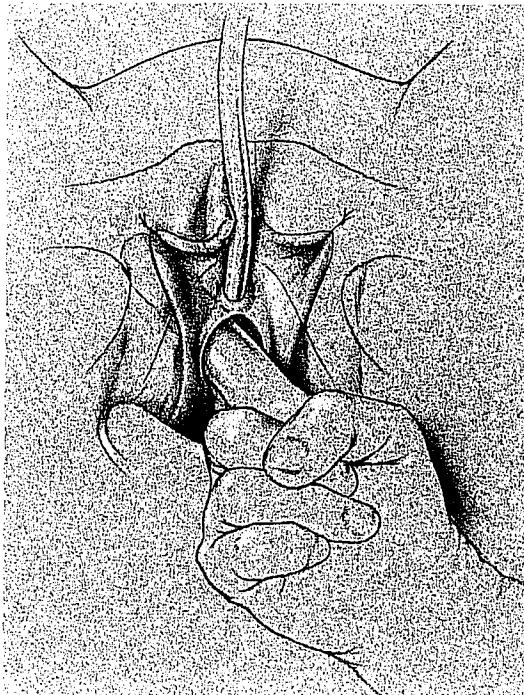


Figure 17-6. The endopelvic fascia is perforated with the index finger, and the retropubic space is entered. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93–101.)

the finger advances and perforates the fascia. This completely mobilizes the vesical neck and proximal urethra, freeing these structures from their vaginal attachments. If the dissection does not proceed easily, it may be necessary to complete it sharply with a Metzenbaum scissors. The scissors is introduced into the proper plane until the undersurface of the pubis is palpated. The tip of the scissors is pressed firmly against the bone and spread until it opens for a distance of 2 to 3 cm. This exposes the proper plane, and the index finger is reinserted to complete the dissection. Sometimes this maneuver has to be repeated several times before the vesical neck and proximal urethra are sufficiently mobilized. If the initial

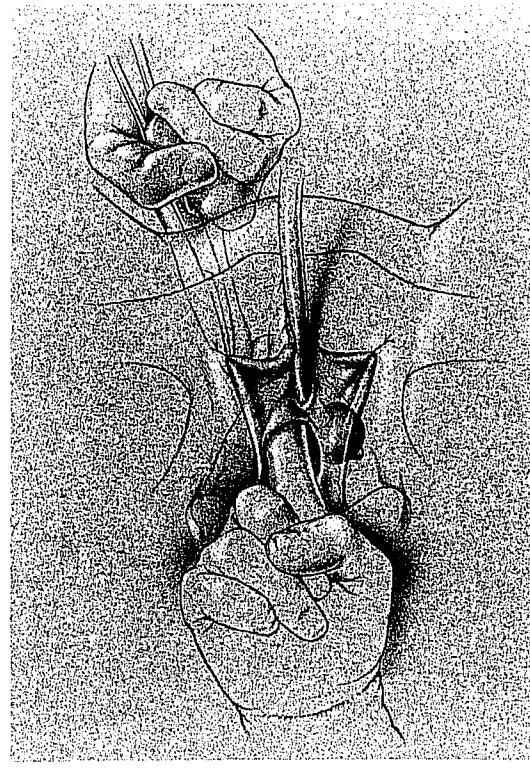


Figure 17-7. A long DeBakey clamp is passed from the abdominal to the vaginal wound lateral to the urethra. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93–101.)

vaginal incision was made too deeply (beneath the endopelvic fascia), however, this part of the dissection will be dangerously close to the bladder and urethra, and inadvertent injury to either structure may occur.

The surgeon's left index finger is reinserted into the vaginal wound retracting the vesical neck and bladder medially. The tip of the finger indents the undersurface of the rectus fascia and is palpated by the index finger of the right hand in the abdominal wound. A 1-cm incision is made in the rectus fascia at the site where the left index finger was palpated.

This is usually just above the pubis and lat-

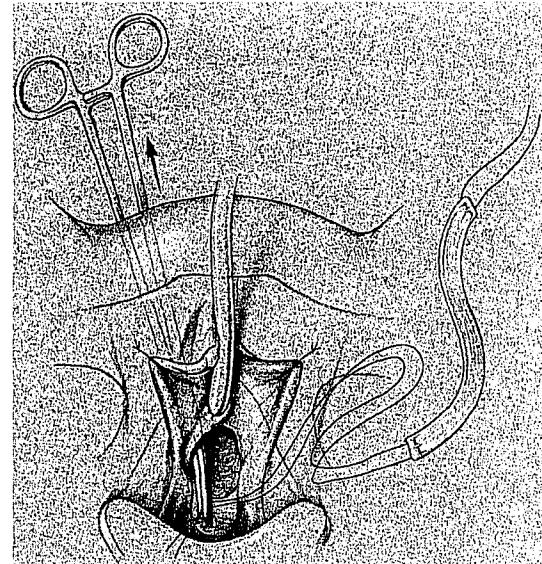


Figure 17-8. The fascial graft is passed around the urethra and brought to the abdominal wound on either side. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93–101.)

eral to the midline on either side. A long, sharp, curved clamp (DeBakey) is inserted into the incision and directed to the undersurface of the pubis. The tip of the clamp is pressed against the periosteum and directed toward the index finger, which is retracting the vesical neck and bladder medially (Fig. 17-7). In this fashion, the clamp is guided into the vaginal wound. When the tip of the clamp is visible, one end of the long suture, which is attached to the fascial graft, is grasped and pulled into the abdominal wound (Fig. 17-8). The procedure is repeated on the other side. The fascial sling is now positioned from the abdominal wall on one side around the undersurface of the vesical neck and back to the abdominal wall on the other side.

Cystoscopy is performed to ensure that there has been no damage to the urethra, vesical neck, bladder, or ureters. A trocar 12 French

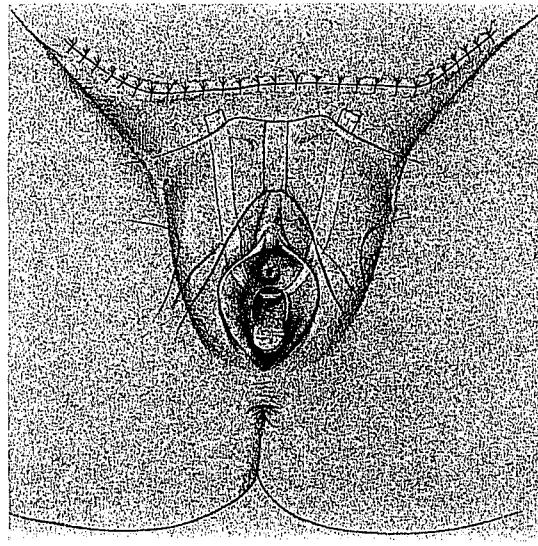


Figure 17-9. The sling is secured to the abdominal fascia on either side. (Modified from Blaivas JG. Pubovaginal sling procedure. In: Whitehead ED, ed. Current operative urology 1990. Philadelphia: JB Lippincott, 1990:93–101.)

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suprapubic tube is inserted percutaneously into the bladder, and its position is visually inspected to be sure that it is well away from the trigone. The vaginal incision is closed with interrupted figure-of-eight sutures of no. 2–0 chromic catgut before securing the sling in place.

The sling is secured to the rectus fascia on either side using the long sutures attached to the ends of the fascial graft. In the majority of patients, great care is taken to ensure that the sling is sutured in place without any tension at all (Fig. 17-9). The only exception to this is when the goal of surgery is to create urinary retention and maintain the patient on intermittent catheterization. We have found no precise techniques for estimating the tension to be exerted on the fascial strip but through experience have decided that it is far better to err on the side of too little tension. At the present time, we use the following method to ensure that excessive tension is not applied: After securing one side of the strip to the rectus fascia, the other side is pulled up through the

contralateral fascial incision until there is no slack in the strip. The suture is then dropped and the strip sutured in place without added tension. If the strip is too short to reach the fascia, it is sutured in place with a whatever gap is necessary to prevent tension. If the surgeon is unsure of whether or not there is excessive tension, cystoscopy is performed. With the end of the cystoscope in the bladder, the suture on the free end of the fascial strip is grasped and pulled upward, while downward pressure is applied to the cystoscope. This depresses the vesical neck and puts the sling on stretch. While maintaining the pressure on the cystoscope, the suture is released, removing the excess tension from the sling. The cystoscope is removed and the sling secured with no additional tension. A vaginal pack soaked in sterile lubricating jelly is left in place.

Postoperative Care

The vaginal pack is removed the day after surgery. Voiding trials are begun as soon as the patient is ambulating comfortably, usually 3 to 7 days after surgery. If the patient is able to void well, the suprapubic tube is removed. If she is unable to void, she is discharged with the suprapubic tube to gravity drainage. One day before her return visit, she again has a voiding trial at home. The suprapubic tube is removed, and if she is still unable to void well, she is begun on intermittent self-catheterization.

Complications

The most important complications of autologous fascial slings are (1) bladder or urethral injury, (2) urethral obstruction, and (3) symptomatic detrusor instability. Urethral obstruction and symptomatic detrusor instability occur in approximately 5% and 10% of patients. We have never encountered a bladder or urethral injury, and there is no modern literature reporting the incidence of such injuries. There has been a substantial number of such reported injuries,

however, during modified Peyrera procedures, and we believe that there is a similar incidence with pubovaginal sling. When synthetic slings are used, the incidence of erosion and fistula formation is as high as 20%.

Conclusion

We believe that the success of the pubovaginal sling is primarily related to improvements in surgical technique. The most important aspects of surgical technique include (1) thorough familiarity of vaginal and retropubic anatomy; (2) confining the vaginal dissection to the "glistening white surface" just beneath the vaginal epithelium; (3) mobilization of the vesical neck from the vaginal approach, freeing it from tethering to the vagina; (4) use of a gently curved inverted U incision over the vesical neck to ensure that the sling cannot slip too far proximal or distal; (5) the use of free grafts of fascia for the sling instead of pedicle grafts; and (6) positioning the graft beneath the vesical neck without tension.

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